Autonomous Real-time Threat-Hunting Robot (ARTHR): Plug-and-play payload transforms commercial robots into effective first responders

ARTHR, an Autonomous Real-time Threat-Hunting Robot, is a first-of-a-kind technology invented to seek and map deadly threats.

Currently, no other capability compares with its combination of robust behaviors, hazard sensors and simple-to-use interface tools.

Easily deployed on many commercial robots, ARTHR's plug-and-play payload sensors can identify hazards such as chlorine, volatile organic compounds, ammonia, radioactivity and explosives.

ARTHR empowers a robot or team of robots with intelligence that significantly reduces workload, training and staffing requirements while keeping operators from harm. It frees operators to focus on hazard detection rather than on the actual control of the robot.

"ARTHR is designed to find things that are going to kill people … radiological hazards, chemical hazards, explosives," said INL robotics researcher David Bruemmer. "The idea is just like with a dog. It's not good enough just to have a sensor, you actually have to have the adaptive intelligence to go out and find the hazard. And this has been quite difficult; in fact, it's been an overlooked problem. ARTHR has an intelligence that allows the robot to not only navigate autonomously, but to actually seek out hazards and figure out exactly where they are and report that back to the human."

INL robotics researcher Curtis Nielsen said, "One key feature of the ARTHR system is the human robot interaction that takes place. What we do is we've created an interface that supports a very simple design and it hides most of the system complexity from the user. The map simply shows the obstacles in the environment and it also shows the hazards that might be detected. And it shows different safety levels … from safe to unsafe environments, so it's very easy for an operator to understand what's going on in the environment.

"The other really neat part about this is that it can be used for all kinds of different robots. It doesn't matter who built the robot or where the robot came from. This system can go onto all of them and it's the same interface for all of them."

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ARTHR supports hazardous tasks in ways that far surpass its nearest competitor, the Army's Chemical Biological Radiological Nuclear Unmanned Ground Vehicle.

A recent head-to-head competition with the Army's robot was staged at Fort Leonard Wood for a chemical detection task. The results showed that despite being trained on the Army's robot, military users were twice as fast with ARTHR, required less than half the cognitive workload and overwhelmingly preferred the ARTHR system.

Another experiment had Explosive Ordinance Disposal personnel use ARTHR to find radioactive sources. Results showed that without ARTHR, only half the personnel could indicate on a map where the source was. However, with ARTHR, all personnel could clearly identify the source location.

The ARTHR system has also been used successfully to autonomously detect explosive material in a tunnel exploration exercise.

"Incredibly high stress, 15-hour workdays, 115-degree heat, the standard issue operator control unit at 31 pounds or the ARTHR alternative at just 16 ounces," said INL robotics researcher David Gertman. "It's an easy choice."

After seeing it operated in the hands of dozens of soldiers and receiving multiple end-user endorsements, several private robot companies are partnering with INL to begin shipping their systems with ARTHR on board.

Impressively, ARTHR delivers advantages in a number of areas. Specifically, ARTHR
- Creates a real-time, 3D illustration of the environment and hazards,
- Expedites task completion while maintaining or improving accuracy,
- Requires a few hours of training, compared with days,
- Reduces operator workload and the number of operators required,
- Functions seamlessly with many existing robot systems,
- Supports a spectrum of interface devices from laptops to hand-held controllers and even a Wii-based controller,
- Has already been adopted by most major robotic players, and
- Has achieved end-user acceptance based on real-world testing.

ARTHR has already beaten the competition. Many of the teams working to provide robots for hazardous missions are now working to use and license this technology. It offers a revolution for human-robot interaction, permitting autonomous robot operations in a dangerous environment with simplified and intuitive direction and support from humans.

The first-of-a-kind ARTHR technology is poised to advance the capabilities of robots to respond to dangerous situations involving security, hazardous materials, explosives, chemicals, radioactivity, and removal of land mines around the world.

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